



skeleton<sup>+</sup>

# Rebuilding industry for a **net-zero** future.

The high power energy storage company.



# Global Reach from the Heart of Europe

Combining German engineering & Estonian IT

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## **Großröhrsdorf, Germany**

- SuperBattery R&D and production
- Supercapacitor research & development center
- Main production location from cells to systems



## **Markranstädt, Germany**

- The largest and most modern supercapacitor factory in the world
- Start of production in 2024
- Curved Graphene supercapacitor production



## **Bitterfeld-Wolfen, Germany**

- Curved Graphene synthesis and production
- Material pilot & development plant
- Solid-state material research



## **Berlin, Germany**

- Sales & application engineering
- Grant & IP management
- Solid-state battery development



## **Tallinn, Estonia**

- Software development
- Electronics engineering
- Module & system development



# Technological Advantage Through Superior Carbon Raw Material

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Backed by the largest R&D team in the industry

## Li-ion Batteries

use a chemical reaction to store energy

 Slow

- + Limited power density (0.5 kW/kg)
- + **High energy density** (205 Wh/kg)
- + Limited cycle life (<3000)
- + Slow charge rate (1.5 C)
- + Safety concerns
- + Lithium, nickel, cobalt

## Supercapacitors

use an electric field to store energy

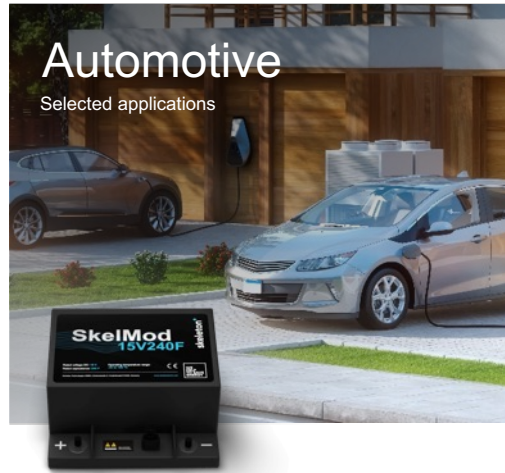
 Fast

- + **High power density** (up to 60 kW/kg)
- + Limited energy density (up to 16 Wh/L)
- + Extreme cycle life (>1 million)
- + Extremely fast charge rate (2000 C)
- + High inherent safety
- + No rare metals

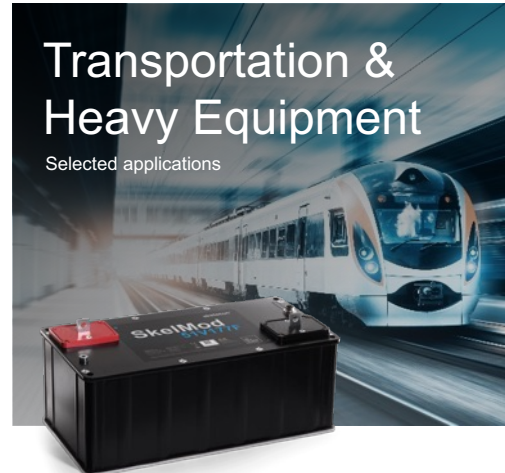
# Key Enabling Technology to Power Electrification Across Industries

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A qualified supplier & system provider to industry leaders



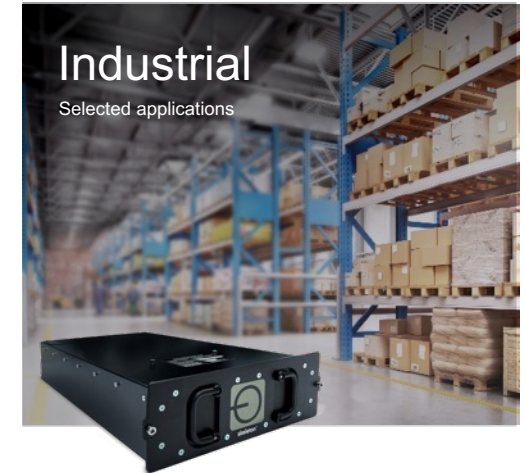
- Fuel cell power support solutions
- 48V active suspension
- KERS / Push-to-pass
- 12V board net stabilization & back-up solutions



- KERS for light rail
- Engine start
- Mild hybrid bus energy storage
- Fuel cell power support solutions for rail and bus transportation



- Wind turbine pitch control
- Virtual inertia / Grid forming in STATCOMs
- Microgrid power back-up and quality



- Peak load shaving to cover short-term peak power demands
- KERS for port cranes, forklifts, and elevators
- Fast-charging for warehouse AGVs and shuttles





# Backed by a Strong Investor Base – Over 200M EUR of Capital Invested



Committed to supporting the company becoming a global market leader by 2024

**Marubeni**



**HARJU ELEKTER**



MM GRUPP

FIRSTFLOOR CAPITAL



Co-founder of

**adyen**

Co-founder of

**wise**

“ **Enabling carbon-neutral electrification** is a key priority for us and Skeleton Technologies fits in our portfolio perfectly. The company has **validated its competitive advantage** in real-life applications and has shown **strong commercial traction.** ”



**Masayuki Omoto**

COO, Next Generation Business Development  
Marubeni Corporation

# Led by a World-class Management Team of Industry Veterans

Energy storage experts, entrepreneurs, and experienced leaders

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## Oliver Ahlberg

Chairman of the Board

- Co-Founder of Skeleton Technologies
- Successful exits in e-commerce and digital marketing



## Taavi Madiberk

CEO

- Co-Founder of Skeleton Technologies
- Member of the board in the European Innovation Council
- Former Chairman of the Supervisory Board of Estonian Railways



## Dr. Linus Froböse

COO

- PhD in solid-state batteries from Technische Universität Braunschweig
- Previously Head of operations at Vitesco Technologies, and Head of Manufacturing Technology Battery and Electric Engines at Continental



## Erkki Raasuke

CFO

- Long experience in finance and banking as CFO at Swedbank, Managing Director at LHV Bank, and CEO at Luminor Bank
- Previously Chairman of Estonian State-Owned Companies Nomination Committee
- Previously Chairman of the Board at Eesti Energia and Estonian Air



## Ants Vill

CCO

- Extensive experience in lean manufacturing and Kaizen consulting.
- Co-founded and sold an Estonian energy savings engineering company
- Member of the strategic advisory board at TalTech
- Previously VP of Product and COO at Skeleton.



## Julian Feiler

VP Engineering

- Formerly Head of Engineering Battery Segment Asia at Vitesco Technologies, Mechanical Design Lead for 48V Battery Systems at Continental.
- Degrees in Mechanical Engineering (B.Eng.) & Technology and Innovation Management (M.Sc.)



## Oliver Osters

VP Technology

- Long experience in cell & module development and industrialization in multi GWh scale in automotive industry as Project Manager at Mercedes-Benz AG and Volkswagen AG
- Strong background in electrochemistry and material science with a PhD in solid state chemistry from Technical University of Munich



## Dr. Jaan Leis

Materials Science Consultant

- Co-founder of Skeleton Technologies  
PhD in Theoretical and Computer Chemistry from University of Tartu, Estonia
- 20+ years in nanomaterials research and co-author of more than 65 peer-reviewed research articles and 20+ patents in the fields of nanoporous carbon and energy storage.



## Dr. Anti Perkson

Materials Science Consultant

- Co-founder of Skeleton Technologies
- PhD in Theoretical and Computer Chemistry from University of Tartu, Estonia
- 20+ years in nanomaterials R&D, co-author of 20+ peer-reviewed research articles and 10+ patents in nanoporous carbon and energy storage.
- Previously CEO and R&D Director of Silmet AS

# From Single Cells to Full Energy Storage Systems

The only full value-chain manufacturer on the market

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## Raw Material

Curved Graphene

## Single Cells

**300-5000F**  
Industrial supercapacitors

## Industrial Modules

**From low to high voltage needs**  
Supercapacitor modules with smart balancing and management systems

## Systems

**MWs of immediate power**  
Modular, supercapacitor-based energy storage systems

# Technology Advantage Throughout the Entire Energy Storage Industry

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Highest performance and quality for every energy storage application, powered by Curved Graphene



## SkelCap supercapacitors (Gen 1)

- 4x power density compared to competitors
- High power (up to 60x compared to batteries)
- 1,000,000+ lifecycles
- Ultrafast charging times (<1 s)

## Graphene supercapacitors (Gen 2)

- +72% increase in energy (16 Wh/L), while maintaining high power
- 1,000,000+ lifecycles
- Ultrafast charging times (<1 s)
- Increased efficiency & lower footprint

## SuperBatteries

- High energy density (65 Wh/kg)
- 50,000+ lifecycles
- Fast charging (60s)
- Extremely competitive cost-base compared to similar energy storage technologies



# Independent 3<sup>rd</sup> Party Verified Advantage

Superior power and energy densities in energy storage

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“Your cells have very low resistance so are truly high-power devices. I think **they are the best in the world of the carbon/carbon type.**”

Dr. Andrew F. Burke

**UC DAVIS**  
UNIVERSITY OF CALIFORNIA

“One property that stands out is the **ESR of the Skeleton capacitor**, which is significantly less than the others.”

C. N. Nybeck, D. A. Dodson, D. A. Wetz and J. M. Heinzel, "Characterization of Ultracapacitors for Transient Load Applications," in IEEE Transactions on Plasma Science, vol. 47, no. 5, pp. 2493-2499, May 2019



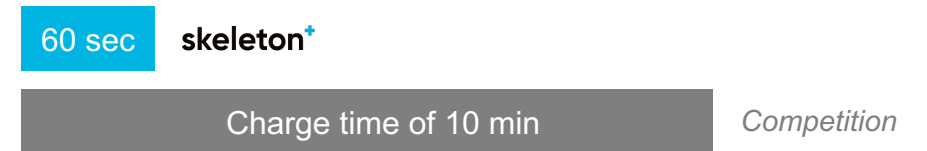
## Supercapacitors

**4X** power density vs competitors



## SuperBattery

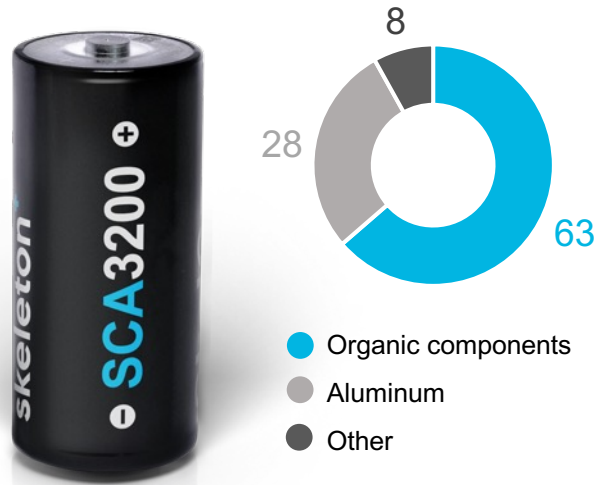
Uniquely fast charge times with high energy density



# Increased Safety Compared to Lithium-ion Batteries

Lower cost due to Curved Graphene and abundance of other raw materials

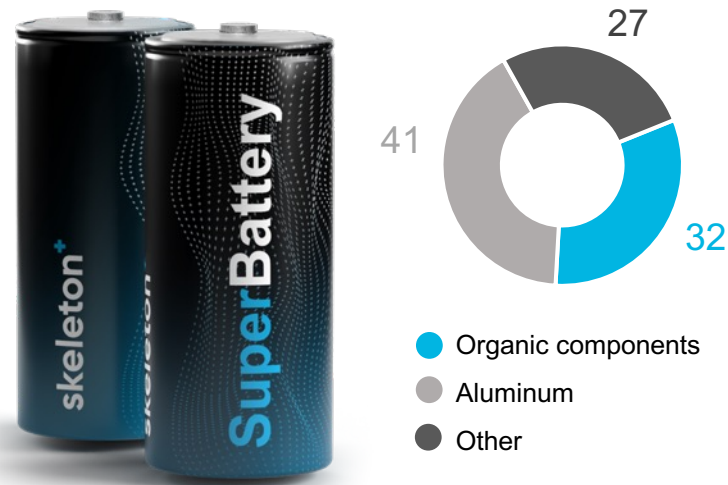
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## Supercapacitor

Composition

- Mostly carbon and aluminum – easy to recycle
- Contains no heavy metals



## SuperBattery

Composition

- Safer to handle than Li-Ion batteries (no lithiated graphite)
- Contains lower cost elements compared to Li-Ion



## Curved Graphene

- Proprietary carbon, produced without any rare earth materials
- Synthesis byproducts re-usable – zero waste created



# The Most Versatile Product Portfolio in Supercapacitor Energy Storage

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The only full value-chain manufacturer on the market

## GEN 1 supercapacitor cells and modules



**SkelCap**  
300-3400F  
cells



**SkelStart**  
12V & 24V  
engine module



**SkelMod 17V**  
5.8F  
supercapacitor  
module



**SkelMod 51V**  
166F  
supercapacitor  
module



**SkelMod 51V**  
177F  
supercapacitor  
module



**SkelMod 102V**  
supercapacitor  
module



**SkelMod 131V**  
supercapacitor  
module



**SkelMod 171V**  
supercapacitor  
module



**Custom Skelpacks**  
Laser-welded  
supercapacitor packs

## GEN 2 Curved Graphene supercapacitor cells and modules



**SkelCap SCX**  
5000F



**SkelMod 54V**  
supercapacitor  
module



**SkelMod 162V**  
supercapacitor  
module

# Modular, Intelligent Supercapacitor Energy Storage Systems

MWs of power, immediately available

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## Systems

# SkelGrid energy storage system

Supercapacitor-based turn-key energy storage solutions for high-power needs





# High Performance Energy Storage - Made in Europe

Fully integrated production – control over the entire manufacturing chain

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The largest  
supercapacitor  
factory in Europe  
(Großröhrsdorf, Germany)

Up to **2M**  
Cells per year

Up to **400k**  
Modules per year

Certified





# Skeleton Materials

Curved Graphene production facility in Bitterfeld, Germany

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**Skeleton Materials** is Skeleton's material development arm, situated at the Bitterfeld-Wolfen Chemical Park in Saxony, Germany.

Led by world-class material scientists and researchers, Skeleton Materials is already the global leader in synthesizing capacity and scaling up Curved Graphene material production to industrial levels to meet the demand for Skeleton's GEN 2 supercapacitors, SuperBatteries, and solid-state batteries.



# German Quality, Certified According to the Highest Standards

Qualified supplier to some of the largest OEMs in the world

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**Linus Froböse**  
COO

**“Quality is the bedrock of Skeleton’s success and something we have put an enormous amount of work in – to produce the most robust and long-lasting products for our customers.”**

Certified



Compliance and selected product certifications



# A Qualified Supplier & System Provider to Industry Leaders

To automotive, grid, transportation, and industrial companies, OEMs & Tier 1s

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German automotive  
OEM



North-American  
Truck OEM





# Supercapacitors Kickstarting Fusion Reactors

Enabling technology to create clean energy

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**120 MW**  
For 3s, enabling plasma  
to be heated to  
**100 million degrees Celsius**




Supercapacitors are used to provide **20 MW of power for each gram of hydrogen to be heated in less than 1 second.** Skeleton is supplying a **global leader in fusion energy.**

# Enabling Higher Penetration of Renewable Energy & Stabilizing Power Grids

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MWs not, kWh business – 50 MW solution delivered



**50% FEWER**  
supercapacitors needed  
for power quality  
applications compared to  
competition



“Most competitive supercapacitor-based ESS for grid applications.”  
(Virtual Inertia)



# Enabling Environmentally-Friendly E-Commerce

Recharging in seconds along the route, no charging space required

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ATTABOTICS

**24/7**

Operation for intralogistics robots, 15+ years or 130 000 working hours of lifetime



“Skeleton’s development work on the ultracapacitor pack provides our system the **power and reliability for constant operation.**”

Scott Gravelle  
CEO, Attabotics

# Solving Issues in Hydrogen Fuel Cell Transportation

The ideal combination of high power and energy technologies

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”Wrightbus is working with world-class leaders such as Skeleton Technologies for supercapacitors. **Supercapacitors and fuel cells are the ideal combination for better performance and lower cost of ownership.**”

Jo Bamford  
Chairman, Wrightbus



# Supercapacitors Electrifying Trams Across Europe

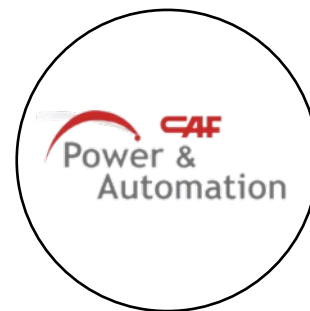
Kinetic energy recovery reduces costs and protects infrastructure

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“Skeleton Technologies brings the necessary quality mindset to critical applications. **The highest power density and efficiency in the industry provides us with a very clear competitive advantage.**”

Stanislaw Wizur  
Škoda Electric



“**Skeleton’s cells are a perfect fit to the rail and tram industry.** Adding them to our energy storage systems will greatly benefit our existing and future customers, **allowing to maximize energy efficiency at an unprecedented level.**”

CAF Power & Automation

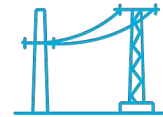
# Key Benefits

To working with us

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IATF-certified & the **largest supercapacitor factory** in Europe



**100+ MWs** of grid & industrial installations, **10 000+** systems & modules in the field



Unique technology & product roadmap with **Curved Graphene**, protected by more than 30 granted/pending patent families



World-class team of **290+ professionals** with vast experience in energy storage development & production



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# Thank you!

For more information  
contact us:

[www.skeletontech.com](http://www.skeletontech.com)

Certified

